THE GLASS INDUSTRY

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# THE MELLON INSTITUTE IS DEDICATED

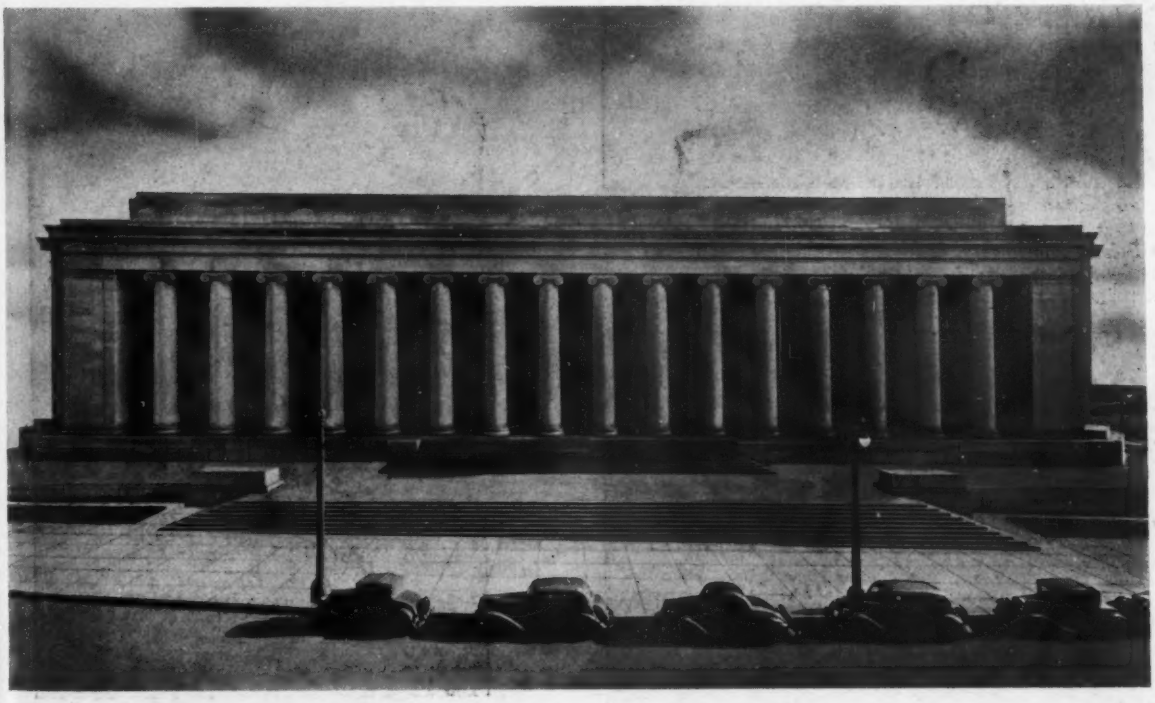
Distinguished scientists, educators and industrialists from many parts of the world assembled in Pittsburgh May sixth to take part in the dedication of the new building of Mellon Institute. It was a distinguished gathering, numbering perhaps three thousand, and befitting the inaugural of the greatest research laboratory the world has ever known.

The ceremonies began informally Thursday morning with an inspection of the building, which was carried on in small groups in charge of competent guides. Then lunch, amid the blinking of flash lamps, as a small army of press photographers singled out their special victims. Formal dedication exercises, presided over by Edward R. Weidlein, director of the Institute, were held in Carnegie Music Hall.

Dr. Weidlein introduced Andrew W. Mellon, the founder. Mr. Mellon sketched the origin of the Institute, which was quite unpremeditated; told something of its history; what it tried to accomplish. He was followed by three Nobel Prize Laureates: Dr. Irving Langmuir, who spoke on "Chemical Research," Dr. Harold C. Urey, "Accomplishments and Future of Chemical Physics," and Dr. William P. Murphy, "Scientific Research in the Solution of Medical Problems." These addresses were shared by a large radio audience. In the evening, a formal banquet was attended by nearly 700 of the guests.

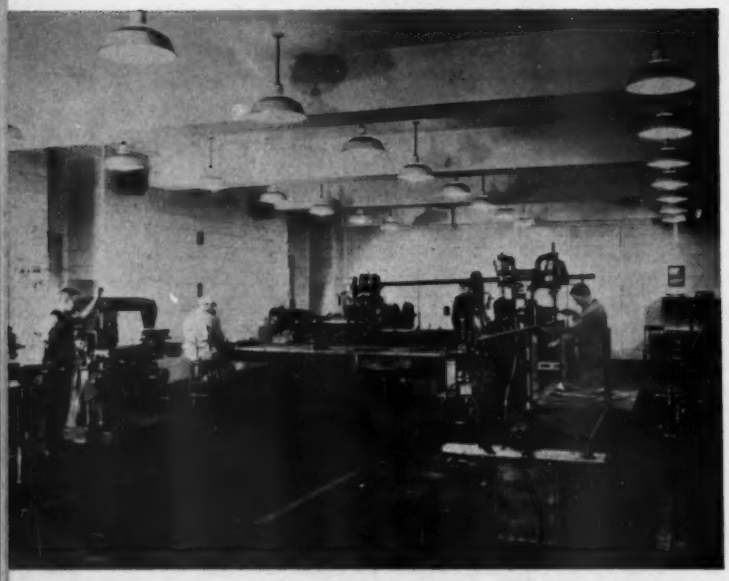
A symposium on "Recent Progress of Science," Friday morning, brought several eminent investigators to the speakers' platform who discussed the very latest developments in the fields of engineering, chemistry and medicine—Dr. Frank B. Jewett, "Communication Engineering"; Dr. George O. Curme, Jr., "The Synthetic Organic Chemical Industry"; Sir Frederick Banting, "Early Work on Insulin"; and Dr. William W. G. Maclachlan, "Problems in the Chemo-Therapy of Pneumonia."

It can be well imagined that an audience such as was gathered together on this occasion would be a critical audience. But it would be difficult for the most severe critic to find anything but praise for the Mellon Institute's new home and what is represents. Architecturally, it is a gem of simple grandeur, however incongruous such a description may appear. In equipment, it embodies every refinement and facility that modern ingenuity can conceive. In personnel, the thought was well expressed by Dr. Weidlein in his introductory remarks: "Here are gathered together many men trained in chemistry, biology, physics and engineering. They help one another directly; and, even more important,



• *The main lobby, of marble throughout. The bas-relief over the doorway depicts the creation of scientific knowledge.*

• *Below: A machine shop, for the use of research fellows who may wish to fabricate some special equipment.*

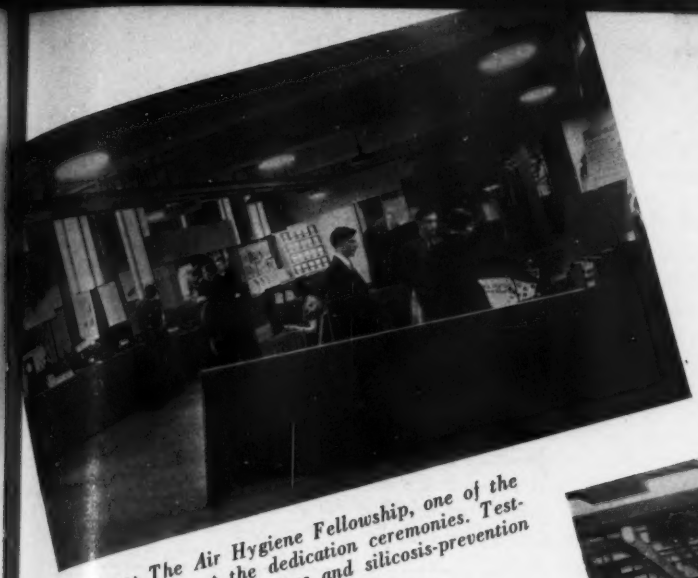


• *Below: The library, with its adjoining stock room accommodates more than 100,000 volumes. It is of oak, in the Renaissance style. A feature is the fine symbolic carving.*

• *The doorway to the social room, made of mirrors set into an aluminum framework. The lintel is of carved Botticino marble.*

# at the Mellon Institu

• *A corridor, with its aluminum gates. This view is typical of the building's interior.*



• *Above: The Air Hygiene Fellowship, one of the many exhibits at the dedication ceremonies. Testing equipment, respirators and silicosis-prevention equipment can be seen.*

• *Right: The Plate Glass Fellowship, by Pittsburgh Plate Glass Company. Interesting demonstrations and displays were shown of tempered glass, double glazing and special glasses.*

• *Above: E. Ward Tillotson, assistant director of Mellon Institute, seated at his desk. Dr. Tillotson was host to a number of glassmen and ceramists.*

• *A typical laboratory, this one being devoted to research in glass. Mellon Institute has provided its research workers with every conceivable facility.*

• *Below: An exhibit of the Abrasives Fellowship, sponsored by the Carborundum Company.*

they create an atmosphere of achievement for themselves in which there grows vision and determination for thorough, careful work. Their success is not accidental. It is the outcome of strong minds and of orderly thought, of good will and of good team work, of seeking toward a great end."

As to the building itself, it requires twenty-eight mimeographed pages to merely sketch its salient features, so we will make no such attempt here. The accompanying illustrations portray the general style of architecture, and with these and a few supplementary paragraphs we will dismiss one of the grandest and most magnificent architectural structures ever achieved.

Viewed from the street, its size is deceptive. Half of the building is below ground level, entrance being on the fourth floor. The whole structure measures close to 6,500,000 cubic feet. Architecturally, inspiration was drawn from the finest examples of Grecian art. Typical, is the colonnade front, with a deep porch behind the columns. Each of the 62 columns surrounding the building, incidentally, is a single, solid piece of limestone, weighing 60 tons. It is the largest monolithic column installation in the world.

Entering the lobby, one finds an appropriate transition from the classic exterior to the essentially utilitarian character within. Here, too, the simple Greek style is evident. Its outstanding features are the beautiful, heavy marble masonry, and the perfect execution of all detail —particularly the ceiling. And so on through innumerable corridors and nearly 400 rooms. Marble, aluminum and glass are everywhere the predominant materials. More than 30,000 square feet of plate glass were required; more aluminum than has even been used in history for a single building.

A word as to the laboratories. The fifth to eighth floors, inclusive, are devoted to this use. Two types of laboratories have been adopted as standard—one, of two windows, is 12 x 19 in size; the other, with three windows, is 19 feet square. Several years of experimental work by the Institute's executive staff is behind the design and equipment of these rooms. Pipes and ducts are concealed behind removable panels. Every laboratory table is built of removable sections, permitting efficient arrangement. Standard service includes air, gas, cold, hot and distilled water, vacuum steam and single- and three-phase electric current; currents of special characteristics can be supplied readily through a plugboard system. Sinks are made of a new material developed at the Institute. Each laboratory has a specially designed combination desk and bookcase.

In the rear of the eighth floor is a furnace room, intended for research on ceramic problems, and the laboratories of ceramic Fellowships are conveniently located nearby.

The Mellon Institute is devoted to the pursuit of pure and industrial research. By many it is regarded as a chemical laboratory. But it is more than that; some very important researches have been conducted in biology, as well as other sciences. Its main objectives, as was emphasized time and again at the dedication ceremonies, are the ultimate benefit of humanity, the conductance of researches having a direct relation to human welfare, promotion of the general welfare through industrial progress. Again quoting the founder, Andrew Mellon, "it seemed to me [in 1909] that improvement in the standard of living of the human race could come about in the future only by reason of new discoveries and inventions, just as, in the past, the steam engine and other inventions have been responsible for many improvements in the standard of living enjoyed by the average man today. It was these things and not governmental or political action, that had increased production, lowered costs, raised wages, elevated the standard of living and so brought about a greater participation of the human race in those benefits."

With the magnificent equipment and personnel now at its disposal, it is fair to prophesy that the Institute will add new laurels to those it already has won and will continue to more than fulfill the aims and purposes of its great and philanthropic founder.

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## NOTES ON JAPANESE GLASS ACTIVITIES

• The frequent news reports of gigantic capital shifts and recapitalizations in Japan's glass industry appear in an interesting light when one considers the organization set-up of this industry as a whole. The complexity of relations among the existing plutocratic groups, which dominate the business, defies classification, but they may be roughly catalogued as follows: The Mitsuis as the largest financial kingdom, strange to say, have no apparent interest in the glass business, but the Mitsubishis, their closest rivals, control through their Iwasaki line directly the Shoko Glass, Asahi Glass and the Window Glass companies. Incidentally, they also control the Kirin brewery interests, which account for 24 per cent of the total beer production in Japan. The Sumitomo concern has the controlling interest in the Nippon Glass and the Enamelled Tile companies.

Also the Yasuda and Okura families have important holdings in the glass industry, and Japan's rising "chemical king," M. Mori, has ambitious glass ideas as well. Surveying the whole field, not a single corporation can be said to be absolutely independent, the bottle business being tied up with the brewery interests, while the sheet-glass line is an exclusive Iwasaki hobby.

In 1907, the late Baron Yanosuké Iwasaki established the Asahi Glass Co., Ltd., as the first enterprise of this kind in Japan. An expert and five skilled workmen were brought over from Belgium as technical advisers. In 1914 patent rights were acquired from the American Window Glass Co., which enabled the company to produce sheet glass by a mechanical process. So the Japan Window Glass Co. came into existence. The Shoko Glass Co. was organized in 1925 under the joint management of the Asahi Glass Co. and the South Manchuria Railway Co. At present these three companies are the only important manufacturers of sheet glass.

• The Nippon Itagarasu K.K. (Nippon Sheet Glass Company) has placed in operation a new plant, located at Yokkaichi, Miye prefecture. Built at a cost of four million yen, this plant initially had an annual capacity of 400,000 cases, but this will be doubled before the end of this year. The company's parent factory at Wakamatsn, Fukuoka prefecture, operates six Colburns rolling systems, producing a million cases annually. The new factory gives them a capacity of 1.8 million cases.

# THE ART OF DECORATING GLASS

## II: SILK SCREEN PROCESS

By V. H. REMINGTON
B. F. Drakenfeld & Co.

• *Continuing the discussion of methods and materials used in decorating glass, this article and the one that follows deal with the silk screen process. The details given here of the construction and operation of the equipment, and the technique involved should prove of great interest to all concerned with the decorating problem. The first article outlined the spraying process; those succeeding will discuss other processes and give patent information and other related data.—The Editor.*

The use of the silk screen process for the decoration of ceramic ware has grown rapidly during the past few years. Not only has its field of application been substantially broadened, but the various methods themselves have been greatly improved. At the present time, with proper equipment, it is little more difficult to print on round or curved surfaces than on flat areas. The silk screen has already become a very important tool for decorating ceramic ware and, judging from past developments, the future holds much for the process.

The silk screen, as adapted to ceramic printing, is really a modern development of stenciling methods dating back to the early Egyptians and Orientals, though it has only been within the last decade that the screen process art has been commercially developed, first for paints, inks and dyes, now for vitrifiable ceramic colors.

It is assumed that the early stencils were made by blocking out, or filling mesh of the screen with a varnish or some other suitable medium so that the printing color could be pressed through the open unvarnished portions. Similar processes, such as the Keyline, Glue Blocked Out Lacquer, Glue-Tusche, and Glue-Sized Screens, are employed today. However, the utilization of a coarse silk screen with a thin paper stencil on the under side was a very important improvement and is purported to be the forerunner of the shellacked and other treated paper stencils.

The silk screen process is adaptable to many fields of work. Among the many uses may be mentioned the decorating and printing of pennants, dress silks, and fabrics; the marking and decorating of toys, wagons, trucks, all types of industrial equipment and furniture, and the production of advertisement signs and displays. The foregoing uses, however, refer only to the method as it is employed for the printing of paints and inks and in that field is referred to as "process" printing.

It has only been within comparatively recent years that the screen method has been generally used for the application of ceramic color. In the glass industry it was used first for printing flat ware, principally signs. Later, with the development of special equipment it became possible to print round objects of many types rapidly. Several colors may be printed in register though to do so each print must be dried before the succeeding one is applied.

### Equipment for the Screen Method

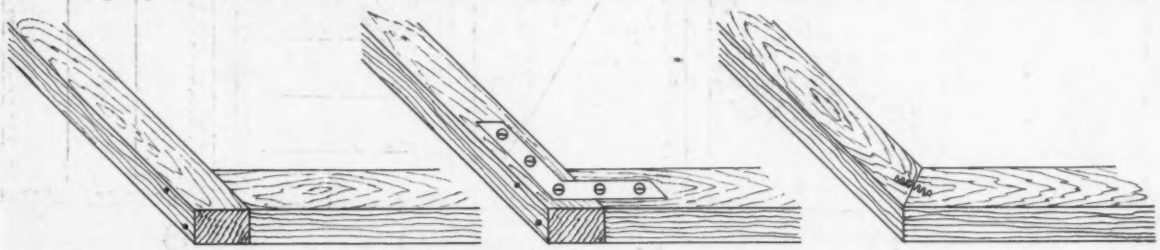
The heart of the screen printing method is the screen plate itself. Whether it is to be used on a machine for decorating round ware or on a table for flat articles, the construction details are essentially the same.

*The Frame*—In the making of screen process frames, the construction details are determined for the most part by the degree of permanency desired by the builder. Further, style and size are governed by the kind of table upon which the process work is carried out. In most shops where the articles to be printed run all about the same size, one or two standard frame sizes should be adopted for the sake of uniformity and conveniences in handling. For table printing it is best to use frames of the floating bar type.

Figs. 1, 2 and 3 show three common types of frame corner construction. A frame, such as is shown in Fig. 1, can be nailed together quickly and is quite satisfactory for small sizes but large frames may suffer from twisting when the fabric is stretched upon them.

For frame material soft, well dressed straight grained wood should be used. The thickness and width of the frame material is left pretty much up to the individual though it is important to keep the frame heavy enough to avoid bowing after the cloth has been stretched. For frames 10″ to 20″ square, material 1″ x 1½″ to 1½″ x 2″ should be satisfactory.

*The Screen*—While several kinds of meshed material can be used for screens, the almost universal use of unstamped silk bolting cloth for the purpose has quite definitely established the term "silk screen process" as meaning screen process printing of all kinds, no matter what the screen material may be. Taffeta silk, and wire



• *From left to right: Figs. 1, 2 and 3. Frame Corner constructions.*

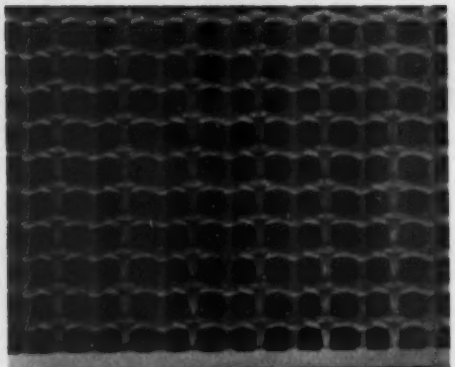


*Fig. 4.*

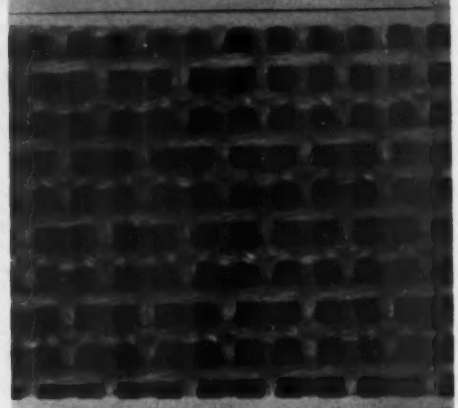


*Fig. 5.*

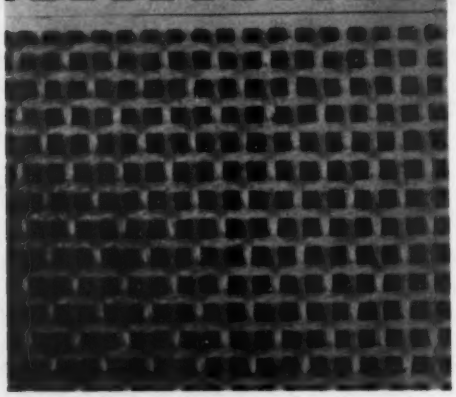


*Fig. 6.*

cloth may also be used. Bolting cloth is an exceedingly strong special silk fabric that may be tightly stretched without tearing. Through common trade practice it is now often identified as stencil silk.

It may be interesting to know that silk bolting cloth is an imported product made principally in Switzerland and France.[1] For years it was woven entirely by highly skilled artisians on hand looms. However, during the past 18 years an increasing amount has been produced by mechanical weaving.

Cloth imported for milling, sifting, screening, and classifying purposes, is so stamped and admitted to this country duty free. Bolting silk to be used in the stencil process is unstamped and subject to 30 per cent duty.

Bolting cloth is made from fine raw untreated silk, from which the natural gums or wax-like secretions of the silk worm have not been removed. It is a tough, uniformly woven cloth and on account of the natural gums, printing colors are not absorbed by it.

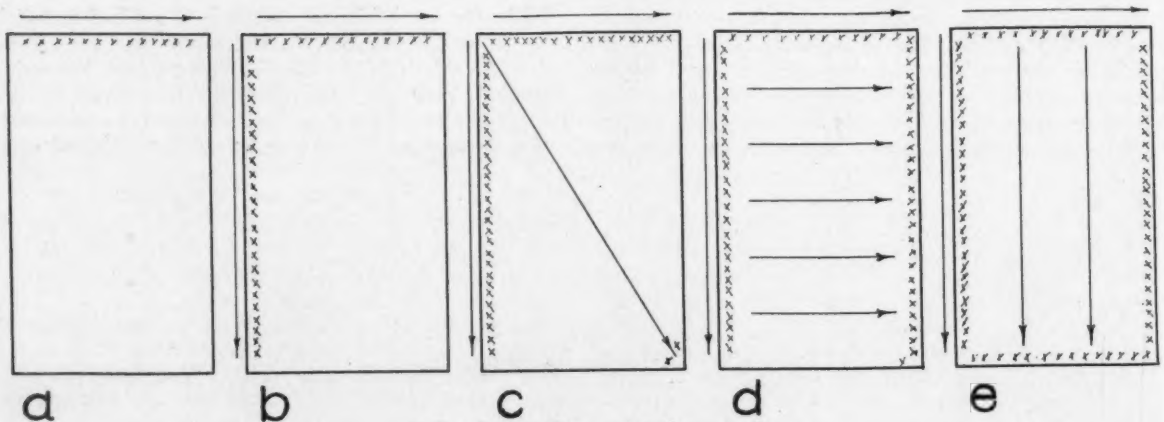
Bolting cloth is sold according to number, the designating numbers being governed by the number of meshes to the lineal inch. It is made in four weights—standard, extra heavy (X), double extra heavy (XX) and triple extra heavy (XXX).

| No. | Mesh | No. | Mesh | No. | Mesh |
|---|---|---|---|---|---|
| 1 | 48 | 8 | 86 | 15 | 150 |
| 2 | 54 | 9 | 96 | 16 | 156 |
| 3 | 58 | 10 | 108 | 18 | 168 |
| 4 | 62 | 11 | 116 | 20 | 176 |
| 5 | 66 | 12 | 124 | 25 | 200 |
| 6 | 74 | 13 | 132 | | |
| 7 | 82 | 14 | 140 | | |

The different weights are governed by the number of single strands twisted into one thread. Bolting cloth is characterized by the special interlocking twist given the threads at points of intersection. This prevents shifting of the weave during printing and results in less wear on the stencil.

There are two types of weaves, one known as full gauze, the other half gauze. Figs. 4 and 5 clearly show the difference. Half gauze silk may be had in all mesh sizes but full gauze silk is not woven finer than No. 12 standard.

Owing to the abrasive action of ceramic color there has been some question as to the practicability of using cheaper silk. For those who feel that their work does not require the use of the genuine bolting cloth, less




● *Fig. 7. Stretching and tacking of silk.*

expensive grades of silk are available. The appearance is much the same but experience has indicated that the percentage of screen failures, especially with machine printing, is much higher with the cheaper silk.

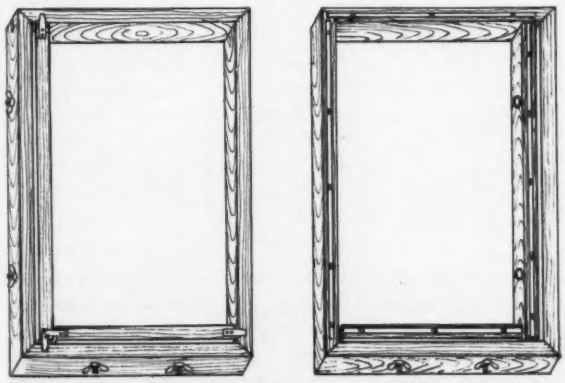
Taffeta silk is least expensive of any of the stencil silk fabrics. As can be seen in Fig. 6 a basket type weave is used in making it, there being no interlocking intersections to prevent creeping of the thread due to the pull of the squeegee. Swiss and Japanese taffeta are both being used to some extent. They are equally strong and durable, though the meshes of Swiss are more uniform.

In selecting the silk, the choice of mesh is dependent both upon the character of the print and upon the kind of film or stencil to be employed. No. 10 or No. 12 silk generally is selected for cut film stencils. In making photographic screen plates nothing coarser than a No. 12 silk should be used unless the method specifically permits the use of coarser material. In fact, No. 14 or No. 16 silk is preferred by some operators, provided the color paste can be successfully worked through the fine mesh. If the design is lacking in detail, silk as coarse as No. 4 may be used with the cut paper stencil, though it is advisable to use a finer silk if the work contains small letters or intricate designs. For general ceramic work No. 12XX silk is recommended.

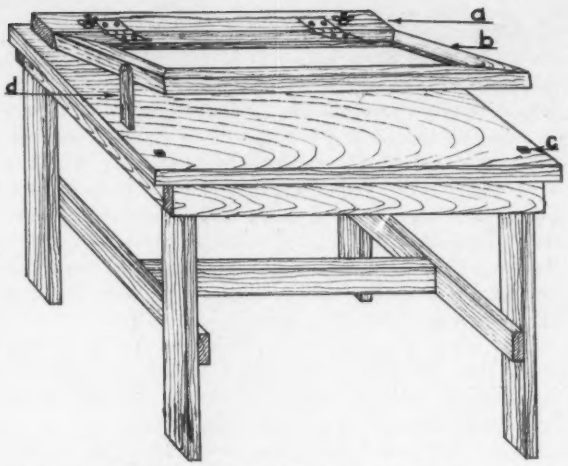
*Stretching the Screen*—The frame should be laid on a solid table and the silk laid across it. The stencil cloth is stretched and tacked with No. 4 carpet tacks. The stretching and tacking operation is diagrammatically sketched in Fig. 7, proceeding as shown by the arrows.

*The Floating Bar Frame*—Floating bar frames are standard equipment in most shops decorating flat glass. The simple mitered frames earlier described are entirely satisfactory for printing the smaller designs, such as bottle labels and trade-marks. They are also satisfactory in cases where the run of any particular job exceeds the life of the silk. However, if the same silk is to be used for several jobs the floating bar frame provides a quick and easy method of tightening the silk after the discarded stencil has been removed, for it is quite essential that the cloth be kept as taut as possible for good, clean cut printing. The tightening of the cloth is done before the stencil has been mounted, never after.

The floating bar frame may be briefly described as a frame within a frame, it being the inner frame to which the cloth is attached. The inner frame is "floating" in that the corners of it are not permanently joined one to the other, but rather are fitted with bolts so that they may be drawn to the separate sides when stretching the cloth. A floating bar frame may be made with either one, two, or four floating bars.



● *Fig. 8 Top, and Fig. 9 Bottom, view floating bar frame.*




● *Fig. 10. Printing table. (a) Adjustable support to which frame is hinged. (b) Screen frame. (c) Stop to hold frame off glass during printing. (d) Support for frame while glass is being changed.*

The two bar frame is probably the most popular type of the floating bar variety. In this type the main frame on one side and end is grooved. In the same manner the floating bars on the opposite side and end are also grooved. To make the cleats easily removable, they should be held in place by means of wood screws properly spaced. Cleats or tongues are then made so as to fit rather snugly in the grooves on the frame and floating bars. When the frame has been completed a base or working table should be made for it. Generally, each shop has developed a standard type table to work well under its particular conditions of operation. In other words, the screen may be hinged at the back of the table so as to be raised principally from one side, or else so devised as to be raised vertically while held in a horizontal plane after each print has been made. The hinged method which is most common is illustrated in Fig. 10.

**The Screen Plate**

Photographic and hand-cut screen plates are used almost exclusively in the printing of ceramic colors. Hiett[2] has described in detail methods for making several different types of screen process plates, including the key-line screen, blue blocked out lacquer screens, single screen blocked out, glue tusche and similar screens, and the glue sized screens. The use of these types, though, has been confined almost wholly to the production of process posters.

At the present time, knife-cut paper and film-paper screen stencils are for all practical purposes the quickest and most easily made if the design to be reproduced is not too intricate. However, noteworthy progress has been made in rendering the photographic screen plate more serviceable, and it bids fair to predominate ultimately.

*Knife Cut Screen Plates*—Of the various types of knife-cut stencils, the beginner can save much time by using film-paper, or prepared duplex decalcomania paper. Film-paper is essentially a sheet of waxed paper which has been coated with a transparent shellac-con-

taining preparation. The use of film-paper is particularly advantageous inasmuch as it is transparent. Duplex decalcomania paper, though opaque, makes excellent stencil material and is more economical to use. It may be made as needed and is thus always fresh. The coating consists of shellac applied in solution by brushing or spraying. The shellac mixture may be made by adding about 15 per cent of castor oil, or some other suitable plasticiser, to an alcoholic solution of orange shellac. If the oil is not added, the shellac film will dry hard and crack. White shellac may also be used but it is easier to judge the thickness of the applied coating when using the orange solution. If the coating is too thin, the stencil may not adhere to the silk. If too heavy, it will melt and run out into the mesh when ironed on, resulting in a ragged edge print.

To cut the stencil, the transparent film-paper is laid over the drawing and the film cut through just to the paper backing, the film being removed from those portions through which it is later desired to print the color. If shellac coated duplex paper is used, the design will have to be drawn on the shellacked surface before proceeding with the operation of cutting the stencil.

Film-paper stencils after cutting should be mounted on the silk in accordance with directions supplied by the manufacturers. In the case of the shellac coated stencil the "iron-on" method should be employed. First, place a piece of cardboard somewhat larger than the screen on a smooth table and on this lay the cut stencil. Place over this the silk covered frame. Next, cover the silk on the inside of the screen with light muslin and with a moderately heated iron press or iron shellac stencil "into" the silk. If the iron is too hot, the shellac may melt through the muslin, but this should be avoided. After the stencil has been uniformly ironed on to the silk, the stencil backing should be carefully pulled away. If in so doing the stencil is loosened from the silk at any point, lay the screen back on the table and touch up with the warm iron.

There are two makes of commercial film paper[3] on the market. Both are transparent, tough, easily cut and attached to the silk. The manufacturers furnish complete instructions therefore details will be omitted.

*Removing Stencil from Screen*—In most instances used screens are stored in racks or cabinets until they are needed again. Occasionally, though, it is known that a stencil will have no future use and in this case it is desirable to salvage the silk. If the silk has been thoroughly cleaned after each printing operation and is free from dried paint it can be used over and over again. Lay the frame on a table stencil side down. Place a heavy woolen cloth on the inside of the frame and saturate with pure methyl (wood) alcohol. After standing 15 or 20 minutes the stencil should literally drop off. Rubbing the silk here and there with an alcohol saturated cloth should clean out any clogged portion. A mixture of one part acetone and one part lacquer thinner is also very good, but highly inflammable. If the screen is the photographic type it is really useless to try to remove the film. The silk can rarely be made clear enough for a second use.

[1] H. L. Hiett: "Screen Process Production," p. 29.
[2] Signs of the Times, July, 1933, p. 22.
[3] Profilm: Profilm Corp., Dayton, Ohio, and Nu-Film: Nu-Film Products Co., Inc., New York City.

## BOOK REVIEW

*Le Béton Translucide* by Dr. Polivka-Jaroslav. Monograph No. 2 of "Les Etudes des Composés Siliceux," published in Brussels, Belgium. Approximately 120 pages, paper covered. This well illustrated little monograph adds one more to the increasing list of books on glass technology in foreign tongues, while the English and Americans continue to mark time.

It seems proper to say that while it may be regarded as a chapter on glass technology, the book is primarily a work for architects. It deals with the form, dimensions, employment and strength of massive specimens of glass in a connected network of reinforced concrete; and the properties of the combined materials. It does not deal with the construction or fabrication of the glass parts themselves in any detail.

There is no exact English translation of the term "béton translucide." A literal translation would be "translucent concrete construction." The first paragraph of Chapter I defines the material as follows: Reinforced concrete, in which are incorporated in great numbers various forms of pressed glass, is described as translucent reinforced concrete, or simply, transparent concrete.

To the best of our knowledge and belief, this form of construction has not made anything like the advances in America that it has made in Europe. From Czechoslovakia to Scandinavia, a number of striking architectural developments with this material have taken place in the last generation, particularly in recent years. While small and primitive examples of this sort of work are to be seen in New England towns and elsewhere, the nearest thing that we have on any scale in America is the development of glass walls of hollow glass blocks, in the forms developed by the Owens-Illinois Glass Company, Corning Glass Works and Macbeth-Evans. There is, however, a radical difference of structure here, and we lag a long way behind the ambitious European development of vaulted and dome construction in pressed glass with narrow fillets of reinforced concrete, which produce such striking effects.

The little work in question gives an outline of the history of the subject and describes the various forms of stressed glass elements available for the work from different manufacturers. The mechanical and thermal properties of the glasses used are dealt with in a somewhat arbitrary fashion, and empirical formulae developed for the strength of the glass elements and the combination with the concrete. Mechanical tests of the combined structures are described, and methods of erecting the rather complex structures. Methods of calculating the strength are gone into in some detail, sometimes on a logical basis and sometimes on an empirical one. Throughout the book the illustrations are noteworthy.

This book should be on the shelves of all glass men interested in structural developments of glassware, and architects interested in new forms of building construction.—F. W. P.

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A recent decision of Justice Genevieve Cline of the Customs Court declares that in the case of merchandise shipped into this country in glass containers, it is not necessary that the container itself be marked as to its country of origin. It is understood that this decision will be appealed.

# IN GLASS-MELTING, MAY WE SAY, LIME IS LIME?

*TRANSLATOR'S NOTE: While the views and experiences set forth by Doctor Zschacke may seem somewhat illogical and almost incredible to those who are accustomed to having a great deal of faith in ultimate chemical composition, and who have been accustomed to think of incidental constituents as slight impurities of no consequence, they must evidently be regarded as founded upon experience. Many instances of slow melting, reluctant plaining, and inhomogeneous glass which have not lent themselves to easy explanation have arisen in almost every factory. It may be that we have been overlooking what has been called, "the role of the minute," which is of unquestioned importance in many chemical processes.*

In *Glashütte* for November, 1936, Zschacke discusses the question whether we may correctly say, "Lime is lime," in glass-melting practice.

As a preliminary to the use of a raw material in glass-melting, a knowledge of the chemical composition is undoubtedly essential. Certain requirements have been established. We know quite definitely how high an iron content in different raw materials may be permitted in order for the sand, or the lime, for example, to be suitable for crystal glass. We know, further, that a good limestone should contain 56 per cent CaO, that the sand should contain at least 99 per cent $SiO_2$, that litharge should not be contaminated with barium compounds or brick dust. We know the chemical composition of the different varieties of feldspar, and that a good feldspar for the glass industry should contain at least 10 per cent alkalis, principally in the form of potash. It is also recognized that in going over from soda ash to potash or from limestone to dolomitic limestone or to pure dolomite, in consequence of the different composition of the pair of materials named, the composition of the resulting glass will be changed and along with it its properties such as workability, annealing temperature, expansivity, etc. On this basis, we always investigate raw materials if we want to change one or another of them, or when we intentionally choose a material of different composition to change our glass in some definite direction.

What has just been said applies only to the chemical properties of the constituents of the raw materials as they enter the body of the glass itself. However, the greater number of raw materials contain, in addition to the non-volatile glass formers, certain volatile constituents which, during the melt, are driven out in the form of gases. We must also take these into consideration in changing raw materials, since these volatile constituents play a considerable role in the melt, and also can powerfully influence the working properties and the color of the glass. The best known example of this is probably the change from soda ash to salt cake, which was under especial discussion in the years shortly before the War. Since the soda content in soda ash is higher than in salt cake, and since the price differential between two raw materials, especially in view of the soda content, was not very great at that time, and since a soda ash melt is more easily handled than a salt cake melt, the replacement of sulfate melts by soda was strongly recommended. Then as people proceeded with this substitution it was found that it was, after all, not quite so simple in different batches. It became noticeable that not only was a certain time necessary in order for the melter to become acquainted with the new type of melt, but that also certain glasses, melted with soda ash, could not be quite plained up; that in green glasses, the color was not quite correct; that the working properties were slightly changed, etc.; so that again today, in spite of the tendency toward soda ash substitution, certain varieties of glass are being melted with salt cake. Thus it may be concluded that while soda out of soda ash and soda out of salt cake are indeed chemically the same, salt cake is not so simply to be replaced by soda, especially if we make the simple assumption that "Soda = soda." Equivalent soda content in compositions otherwise equal does not necessarily produce the same glass from the viewpoint of melting, plaining, workability, etc.

A further example of this sort of thing is potash, which is supplied to the glass industry in three different forms. There is first, the old "classical" potash which was obtained from molasses and other organic raw materials. It is known, in the glass industry, under the name of "refined potash" $^{80}/_{82}$ per cent. It contains in addition to potassium carbonate, important quantities of sodium carbonate, that is, soda ash, as well as some potassium chloride. This finds application especially in the illuminating glass industry, because this type of potash furnishes an especially good development of opacity. If this potash is replaced by one which does not contain the incidental constituents above named, and if the soda which would otherwise be supplied by the potash is put in as separate soda ash, the melt does not proceed quite so smoothly, the opalescence is weaker, the melt goes more slowly, plaining is delayed, because the potassium-sodium carbonate melts at a lower temperature than the mixture of potash and soda ash and because certain substances were carried into the glass by the old refined potash even though they were not wanted in other glasses and were not to be found in other varieties of potash. However, in the alabaster and similar opal glasses, they were beneficial, promoting opacifying.

The two other varieties of potash which are used in the glass industry are the hydrated potash, $^{83}/_{85}$ per cent, with about 16 per cent water of crystallization; and the refined, calcined potash, $^{96}/_{98}$ per cent. which is usually very pure. If it is desired to substitute, every other day, one potash for the other, say the hydrated for the calcined, one would again have to reckon with upset melting conditions and color effects, and there would also be slight differences in workability. This is because the water of the hydrated potash not only quietly escapes during the melting down of the raw materials, but because this water has an important part to perform during the melting and the plaining, and also, to some extent, remains behind in the finished glass. Here, in spite of its small amount, the water can have an important influence on the color and the working properties of the glass. Almost as well proven is the case of water-free and hydrated borax, where in like

manner the removal of the water before introduction into the batch takes away part of the effect of the borax upon melting and plaining. Similarly, there is a difference between putting in boron oxide as borax, or as boric acid and soda ash.

When alumina is under consideration, the inaccuracy of the law "soda = soda" or "oxide A = oxide A" stands out with especial force. Whether alumina is introduced as alumina hydrate, as kaolin, or as feldspar, or as other minerals into the glass batch (so that the finished glass shall exhibit always the same chemical composition) is by no means all one, so far as the melting and refining properties are concerned. And, as already said, even in the working properties of the glass, the effects of different batch ingredients can be recognized. Whether some effect may be discovered also on the properties of the finished glass may be surmised, but is, however, not certainly known. On the other hand, in enamels, the effects of the choice of raw materials on the finished enamel are well established. In any event, a batch with feldspar melts down much more readily than a batch with kaolin, and phonolith makes the batch melt down still more easily, independent of the varying tendencies of the designated aluminous raw materials to form stones and cords. The same thing happens when MgO is put into the glass along with CaO. Here it is by no means all the same as far as the melt is concerned, whether both oxides are used separately, as lime and magnesia, or whether the two oxides are put in together as dolomite.

However, this series of sources of trouble, which lie in a change of raw materials, is not complete. Raw materials of like chemical composition, but of different origin, may not always behave quite the same in the melt. The best known example of this is sand, where the grain size plays such an important part. It has been observed that a sand of very fine granulation melts down very rapidly indeed, but that the glass plains with difficulty. Whereas sand of a large grain size lets the batch melt down more slowly, but permits more rapid refining. The cause is understood and need not be discussed here.

Soda ash presents us with another example. Until recently, we had only two different kinds of soda ash (aside from the Le Blanc soda ash, which has long disappeared from the glass industry), which began taking a predominance over salt cake, namely, light and dense soda ash. With the change from the light ash to the heavy, or vice versa, certain disturbances arose which could be made to disappear only some time after the melter had replaced the former soda in the melt. Similar phenomena have been observed when the third variety of soda ash, granulated, was introduced. In certain factories, where the former fine granulated soda had been replaced by the granular, it was found, as a matter of experience, that 98/99 per cent pure soda ash in melting and refining would not always show the same behavior; but, according to the degree of granulation, one soda ash would act thus, and another one otherwise, and melting had to be adjusted to the new granulation.

According to these two examples, the sand and the soda ash have behaved according to physical differences in their preparation. Different behaviors in melting and refining between materials of practically the same chemical composition and like physical condition can also arise, if the raw materials have been prepared in a different manner or originate from rocks of different localities. For the first case, potash offers us the best example. Having seen that the different varieties of potash, as the refined, hydrated, and the calcined, behave differently during the melting and refining processes; we can understand, further, that there will be differences in behavior, when with the same chemical composition, potash from an organic source such as molasses is compared with that from the mined potassium salts. Observations of the melting process on the large scale have shown, without doubt, that organic potash permits the best melting down of batch, favors the elimination of bubbles, and produces a purer color than the "mineral" potash. The cause of this has not been completely cleared up. Some would lay the effect to the small amounts of incidental constituents in the "organic" potash, which it has picked up from its original sources and which are lacking in the "mineral" potash; others, on the contrary, believe that the source of the different behavior is to be found in a "structural" difference which is also indicated by the different behaviors of the two varieties of potash toward atmospheric moisture: "organic" takes on water less easily than the "mineral."

As a further and final example, let us consider lime as an example for a different behavior during the melting, conditioned by its origin from different localities. Here the various causes which have been named hitherto may be overlooked and discarded: slight differences in content of accompanying constituents, which as a matter of quantity scarcely come into consideration (since we work certain limestones which contain more than 99 per cent calcium carbonate) different granulations in milling, different mineralogical form as limestone, ground marble, calcite, massive limestone, marl, chalk, mussels shells; different geological history, etc.; nevertheless, lime is a typical example of how careful one must be in making changes in the batch by substitution of raw materials. Even if the analyses, as we have already remarked, show that one limestone is exactly like another, the two varieties will not necessarily behave the same in the melt, and the formula "Lime = lime" may be just as incorrect as the formula "Soda = soda."

All this leads us to propose, in conclusion, an important question, "What is, after all, the significance of analyses, when in spite of equality in chemical composition, such differences in melting behavior may arise?" The analysis is of essential importance because it clears up the question of iron content and the presence of accompanying constituents (we had rather not call these impurities, since this term is not completely descriptive), and it gives us information as to which raw materials to select for the intended purpose, or what rearrangement of the batch may be necessary if a change of raw materials is to be made. On the contrary, the analysis does not free us from the necessity of proceeding cautiously with these changes and of taking the "imponderables" into consideration, which we cannot recognize from the analysis. These effects of unweighable things we can generally not demonstrate by crucible experiments, and this may well be the reason why they have hitherto found so little notice. They first appear in meltings on the large scale, and their disturbing influences can be eliminated only by careful observation of the melt, and gradual substitution of new raw material.

# THE PHYSICAL CHARACTERISTICS AND PROPERTIES OF TEXTILE MATERIALS MADE FROM GLASS

By JOHN H. THOMAS*

For centuries glass fibers have been put to special uses, and since the first decade of the twentieth century, they have taken their place in the commercial field. In Germany, during the World War, a method was perfected which allowed for comparatively rapid production of a crude glass fiber insulating material. However, this process did not allow adaptation to American production methods and was so designed as to make control almost impossible. This material was used to insulate German battleships, where resistance to shock and salt water are essential. Material, being manufactured by the Owens-Illinois German licensee, is still being used by the German navy, and several other countries have adopted Fiberglas insulation for their newer ships, and for installations on renovated sea-fighters.

Much data on the physical characteristics of the Fiberglas insulating materials have been accumulated. Sufficient to say that it compares very favorably with the best insulating materials known, having a thermal conductivity of 0.226 B.T.U./hr/°F./sq.ft. at a mean temperature of 70° F. The tensile strength of individual fibers in Fiberglas averages 250,000 pounds per square inch, and several results have been obtained of 3,500.000 pounds per square inch, which is 25 per cent of the theoretical strength of glass, calculated from the lattice and vanderwaal's forces involved.

The first glass fibers that were produced commercially by the Owens-Illinois process were large, being about 0.02 inch in diameter. These fibers were laid down on a conveyor where they formed a jack-straw pack which was the starting point for the first product, the Dustop air filter. The fiber diameter of this first glass fiber could be varied sufficiently so that two distinct types of pack were produced.

The glass fibers were bound together with a suitable binder and a strong adhesive was applied to the resultant mat. To give good efficiencies in air filtration, a progressive pack was used, that is, the coarser type packs were placed on the entrance side of the filter, while the finer fiber packs occupied the rear position. Thus, large particles of dirt and pollen were filtered out on the entrance side, while finer particles were removed by the finer pack which, having smaller openings between the individual fibers, broke the air into much smaller streams. The efficiency of these filters is 95 per cent when common dusts are encountered, and their life depends upon conditions of service, that is, rate of air flow and percentage of contamination of the entering air.

With the development of a small fiber, progress in the insulating field was rapid, and now Fiberglas is applicable, in one form or another, such as blanket, "bat" or felted material, to almost all insulation problems, either for heat or refrigeration.

It was only a short time later that further refinements in the operation allowed for the production of fibers of 0.0002 inch diameter, at which time glass fiber first became a potential textile material. After three years of further development work, Fiberglas textiles are now ready for commercial application in two fields, and they are on the verge of perfection for many additional uses.

At the present time it is felt that glass textiles can serviceably enter the chemical filtration field. Here the inherent ability of glass to withstand attack of salt and acid solutions plays a large part in its acceptance bv the trade. In addition, temperature has no effect upon the glass fabric being used as a filtering medium. But these two advantages are not the only ones which arise from the use of glass for this purpose.

Extremely high flow rates are obtained with glass textiles. This is explained by the fact that, per unit of area, there is approximately six times the open space for passage of liquid in a glass cloth that there is in a cotton cloth giving the same yield. This means that only one-sixth the pressure need be used with glass cloth. The reason for this great variation in necessary pressures is found in the comparative diameters of the glass yarn and cotton yarn. Where the cotton may be compared to a man's finger, glass is comparable to a match stick. Thus, the cloth can be so constructed that the solids filtered out will be the same, but liquid will be passed much more readily by the glass cloth.

Amazing stability of the new glass filter cloth has been revealed in tests where acid filtering is required. Chemists usually use filters of wool or nitrated cloth. They become useless in about 10 days. Under tests with liquids of 30 per cent sulphuric acid at more than 200° F., unusually severe conditions, glass filter cloth stood up for 40 days. And the glass technicians expect to improve this "life span" considerably.

As yet it is not practicable to use glass cloth under alkaline conditions. However, development of suitable glass batch is going forward, and it is expected that soon glass cloth can be recommended for use under all conditions.

The composition of the glass batch is of extreme importance in the manufacture of Fiberglas. It is a well known phenomenon that materials in finely divided state have reduced melting points from those in bulk condition. For instance, common soda-lime glass, with a melting point of approximately 1100° F., in fiber form has a melting point of approximately 250° F. For this reason, special glasses have been developed to use in Fiberglas products throughout the entire line, and specifically in textiles where the fiber diameters are extremely small.

In the field of electrical insulation, Fiberglas is finding a number of applications. In yarn form it is used to wind small wires and cables. In tape form it is used for winding larger units, such as coils for motors and generators, and in transformers. If an impregnation is used, it is applied in exactly the same manner as that

(*Continued on page* 211)

* From a paper delivered before the American Ceramic Society, New York, March 23, by John H. Thomas of the laboratory staff of the fibrous glass division of the Owens-Illinois Glass Co.

# ASSOCIATION ACTIVITIES OUTLINED AT G. C. A. MEETING

Of unusual interest was the annual meeting of the Glass Container Association at the Greenbrier Hotel, White Sulphur Springs, W. Va., May 20-21. The agenda listed three topics of vital importance to both the glass and closure industries, besides the annual "state of the nation" report by E. G. Ackerman, assistant business manager.

The keynote of the fiscal year 1937 was struck by C. R. Stevenson, business manager of the Association, in his analysis of current business trends in both fields, as evidenced both in private reports of members of the association and the reports to stockholders by several large companies.

The business world is definitely on the rise, and the glass container field is obtaining its share of the increased prosperity. Mr. Stevenson predicted this increase would continue for several years, with stabilization of buying power and production coming somewhere around 1940.

In an analysis of the current boom, the cause may be interpreted as a direct result of a price rise anticipation by various companies. These have launched new enterprises which in all their ramifications have stimulated various contributing industries. This naturally has provided more buying power all along the line. It was predicted that the absorption of this additional enterprise, plus the annual fall release of the great purchasing power of the farm unit would cause another short stimulation of business at the end of the current year.

Another topic of vital importance to any industrialist is labor relations. To this problem the right approach must be found. Whiting Williams, in addressing the Convention, took the viewpoint that the employer must have the commodity which the employee has to sell: his labor. He placed the subject of labor-employer relations on a strictly sales basis. Capital is engaged in a selling competition with Union organizers to win labor's allegiance; and in any sales campaign it is axiomatic to "know your customer."

In developing this point Mr. Williams categorically divided labor into three groups. First are those who are favorable to the employer or "20 per cent pro-employer." Opposed to these are the "20 per cent pro-union," while in the center are the great majority, the 60 per cent who are undecided and to whom a job is simply a means of livelihood. The winner will be the side which corners the majority of that 60 per cent. To do this the employer must know his employees. An intimate contact must be maintained so that he may know the needs, difficulties, problems and desires of those who by their effort make his product marketable.

The majority of employers today are under a handicap because they are taking their adversary (the labor unions) more seriously than their employees, while the Union is closer to the real facts, and through its agents and organizers establishing sympathetic contact with the worker.

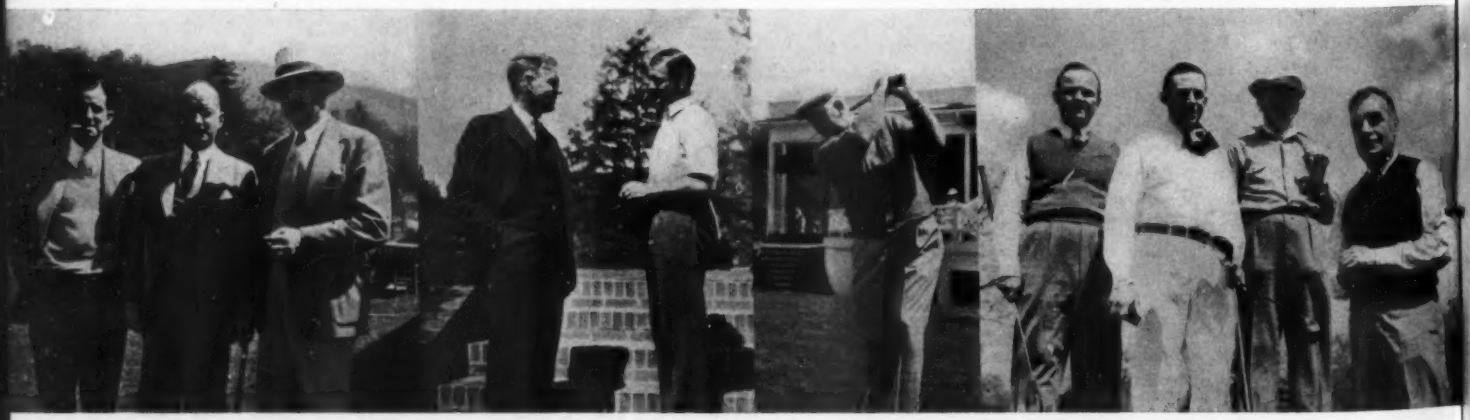
From his analysis of labor relations Mr. Williams predicted the final failure of the C.I.O. Although Unions as a whole do understand the worker, they do make one great mistake. In their regimentation they fail to grant sufficient importance to the worker's natural pride in his job and his accomplishments.

Always of interest are the review of the Association's activities and the statistical analysis prepared by Mr. Ackerman and Mr. Hall, respectively. And naturally these reports are of unusual interest when they give an unusually satisfying picture. The present membership makes the Association truly representative of the industry in its inclusion of 41 glass manufacturers, 42 cap and closure makers and 24 members from allied industries; a total of 107.

*Legislation*—Due to the difficulties over the Supreme Court issue and the consequent inability to determine the legislation that has a chance of being successful, the Association has taken no active part in legislative matters during the past year. However, it is understood that the Administration is preparing new legislation on hours and wages, and industry control. It is also understood that the Anti-Basing Point Bill is being re-drafted and will be presented during the present term of Congress.

**The Tariff Situation**

Mr. Ackerman pointed out that, although foreign competition in both perfume and common bottles has not been an important factor during the past year, the improvement in the quality of Japan's automatic and hand-made glass may become an important competitive factor. While the Association has a dumping case pending

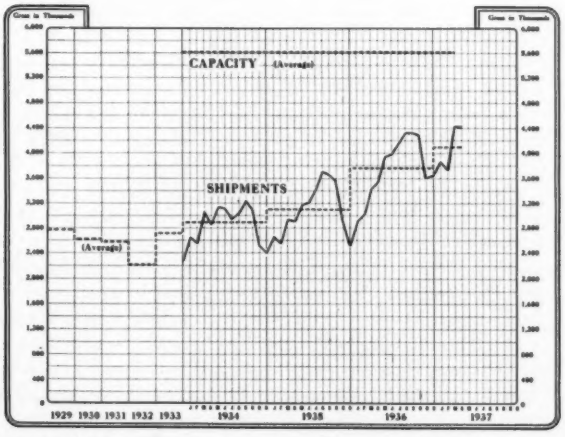


● *From left to right: J. M. Foster, Randall Barnard, Roy A. Blunt, Victor Hall, Philip Heuisler, Robert M. Kimball, R. M. Moss, H. J. Carr, I. R. Stewart, Brooks Brown.*

against Japan, the difficulty of securing accurate information on the importations makes it doubtful that the case will be successful.

The Administration has just announced that a reciprocal agreement will be negotiated with Czechoslovakia. Since glass is one of the important commodities imported from Czechoslovakia, it is likely that glass will be considered in the treaty. If Czechoslokavia is given a reduction in duty on glass, this, of course, means that it will apply not only to the imports from this country, but will apply to all other countries covered by our most favored nation treaty. With constantly increasing labor and material costs in this country, it is believed that such a reduction could be a serious matter for the glass industry. The Association will very strongly insist that glass should not be considered as a bargaining commodity.

The Administration has also proposed a bill, H. R. 6738, which will change many of the important administrative provisions of the Tariff Act of 1930. This bill would place the jurisdiction of our tariff law under the Treasury Department, making it more or less political. The custom service has been an independent body, created by a special act of Congress. In addition to this important change, the law would change many of the provisions which are favorable to domestic manufacturers. This legislation is being opposed because these important changes in the administrative features of the 1930 Act would tend to break down our entire tariff law, and the protection afforded to domestic producers.




● *Total industry shipments compared with productive capacity by months.*

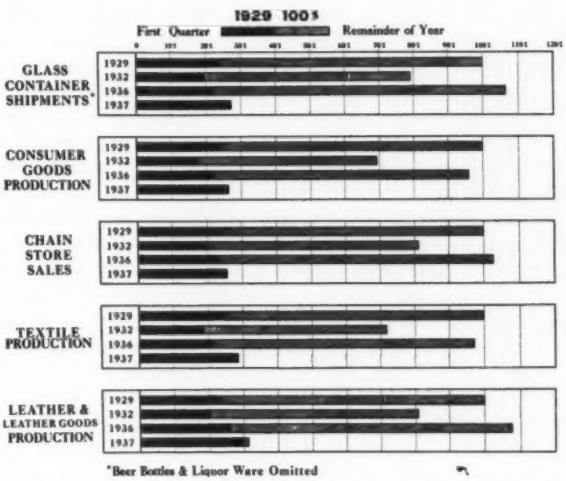
**Trends in Beer and Liquor**

Although the Treasury Regulations requiring the marking of all liquor bottles have worked very smoothly to eliminate many of the evils that have come into the liquor business, there are still many things that must be done if the beer and liquor industries are to elevate themselves to a position of permanence in this country. In short, the Anti-Saloon League appears to be making alarming progress.

Recently published data in the *Cleveland Press* show the trend in Ohio is definitely towards restriction of the sale of alcoholic beverages. This is a fair representation of the trend in many other states, following closely the procedure leading to the Eighteenth Amendment.

All the groups interested in preserving the beer, wine and liquor industries are cognizant of this movement, and are taking steps to combat it. Recently organized were the Distilled Spirits Institute, the United Brewers Industrial Foundation, and Captain Stayton's Repeal Associates. These industries are important to the prosperity of the glass container industry, and in the interest of proper regulation to eliminate existent evils, it should study the situation and support those groups doing the most effective work.

The competition of the beer can is a retreating spectre. All indications seem to be that the beer can passed its peak and is declining in almost direct proportion to its




● *Glass container shipments compared with activity in various industries.*

rapid rise two years ago. Although the package beer sales for 1936 are 52.4 per cent over 1935, it is estimated from reliable figures that the maximum in cans of the 20-odd million barrels of beer packaged would be 10 per cent. Despite extensive advertising, through all media, amounting to a rumored $1,000,000 during 1937, the situation seems to be well in hand for bottles, particularly the steinie. In this connection the attempted use of cans for wine is understood to have proved unsatisfactory due to spoilage. Laboratory reports indicate the present can not suitable for wine.

*Milk Bottles*—The use of paper milk containers has spread to Detroit, Baltimore, Atlanta and towns outside of Pittsburgh and Chicago. An experimental advertising campaign utilizing three newspapers and radio spot announcements was therefore carried out in Cleveland, one of the original strongholds. A contest run concurrently pulled 60,000 replies. Some scattered results showed that "paper sales in one large chain dropped from 40 per cent to 10 per cent; paper sales in another large chain dropped 35 per cent; more milk in glass bottles is being sold and at least 50,000 women in Cleveland are familiar with advantages of buying milk in glass bottles." The Cleveland dairies have also offered further cooperation.

In Baltimore, in a somewhat different situation, the dairies have all agreed to meet paper with paper at the introductory price of this type of container. In addition the retailer will get an extra cent and a half profit on glass bottles. Again advertising will be used to tell Baltimoreans of the advantages of seeing what they buy.

(*Continued on page* 206)

# NEPHELINE SYENITE

**By R. B. LADOO**

Nepheline syenite enters the glass industry as a source of alumina. It is a rock, of high alumina content and contains primarily the minerals nepheline (or nephelite[1]) mixed with potash and soda feldspars. It also contains minor amounts of such accessory minerals as magnetite, muscovite mica and occasionally biotite mica, pyrite and a few others. The glassmaker is more or less familiar with other sources of alumina, but nepheline is probably a new mineral to him in the sense of commercial usage.

Nepheline, mineralogically, is a sodium aluminum silicate which always contains, in the natural mineral, a certain amount of potash. An artificially prepared nepheline is a pure sodium aluminum silicate with the formula, $NaAlSiO_4$ or $Na_2O.Al_2O_3.2SiO_2$. The natural nepheline, containing potash, has been given the formula $K_2Na_6Al_8Si_9O_{34}$ or $K_2O.3Na_2O.4Al_2O_3.9SiO_2$. It has been suggested that natural nepheline may be a molecular combination of $KAlSiO_4$ ($K_2O.Al_2O_3.2SiO_2$) and $NaAlSi_3O_8$ ($Na_2O.Al_2O_3.6SiO_2$). Natural nepheline has a hardness in the Moh's Scale of 5.5 to 6, specific gravity 2.55 to 2.65 and index of refraction of 1.538 to 1.542.

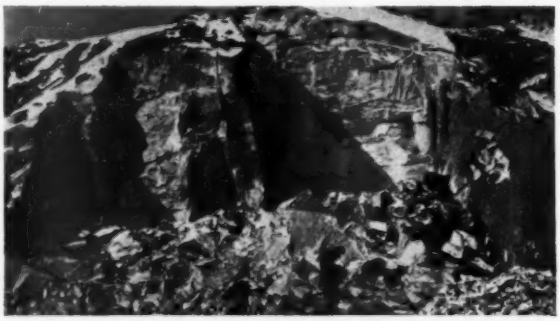
Nepheline, therefore, is closely analogous to the potash and soda feldspars in composition and properties, but differing from them in the relative percentages of alumina, silica and alkalies and in the soda-potash ratio. And in nepheline syenite we have a combination of the compositions and properties of nepheline with the feldspars. In order that these close relations may be understood and compared, the following table of theoretical and actual analyses is given:

TABLE 1

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $SiO_2$ | 42.25 | 44.1 | 59.30 | 64.7 | 68.7 | 69.0 |
| $Al_2O_3$ | 35.92 | 33.2 | 24.70 | 18.4 | 19.5 | 18.0 |
| $Fe_2O_3$ | — | — | .06 | — | — | .06 |
| $TiO_2$ | — | — | .01 | — | — | — |
| CaO | — | — | .27 | — | — | — |
| MgO | — | — | .02 | — | — | — |
| $Na_2O$ | 21.83 | 15.1 | 9.91 | — | 11.8 | 2.0 |
| $K_2O$ | — | 7.6 | 5.10 | 16.9 | — | 11.0 |
| Loss on Ign. | — | — | .44 | — | — | — |
| | 100.0 | 100.0 | 99.80 | 100.0 | 100.0 | 100.06 |

(1) Theoretically pure artificial soda nepheline.
(2) Theoretically pure natural soda-potash nepheline.
(3) Blue Mountain (Canada) nepheline syenite; analysis quoted by Koenig.
(4) Theoretically pure potash feldspar (orthoclase or microcline).
(5) Theoretically pure soda feldspar (albite).
(6) Average composition of typical feldspar used by glass industry.

Since it is usual to compare anything new with the thing most nearly like it in our experience, we may compare nepheline syenite (No. 3 in Table 1) with a typical feldspar (No. 6 in Table 1). We note at once that nepheline syenite has about 10 per cent less silica than feldspar, about 6 per cent more alumina, about the same iron oxide and about 2 per cent more fluxing oxides. The potash and soda relationships are reversed, nepheline syenite having about twice as much soda as potash, while the feldspar has only about 18 per cent as much soda as potash. The significance of these comparisons will be discussed more fully later.



• *The Canadian Nepheline quarry at Methuen Township, Ont. The quarry face is 100 feet high.*

It should be emphasized again that nepheline syenite is a rock, composed of at least three alkaline silicate minerals in varying proportions, of which nepheline is only one. Nepheline syenites from various localities differ in their nepheline content, in their uniformity and purity. The nepheline syenite which will be discussed primarily in this paper is that from Blue Mountain, Methuen Township, Ont., Canada, and is the only nepheline syenite which has been produced commercially. Other deposits are known but for various reasons have not been developed.

The Blue Mountain deposit has been described several times in the literature and only the commercial aspects need be touched on here. This deposit is located near the northern end of Stoney Lake, northeast of Lakefield, Ont., the nearest railroad point. It extends for several miles in the form of a long, high, bare, stony ridge. Samples taken along and across the ridge show remarkable uniformity over wide areas. No real attempt has been made to estimate tonnage, but from the evidence afforded by the present quarry opening and surface sampling several million tons are readily available.

The quarry, opened part way up the ridge, now has a working face about 100 feet high, with the face growing higher as it advances into the ridge. The overburden varies from nothing to perhaps eight inches and there are no open cracks, mud seams, pockets, or inclusions of impurities. This makes the quarrying problem a simple one and cobbing, sorting and hand selection are unnecessary.

The rock is drilled, shot down in benches, blocked, holed and shot again, then sledged by hand to the size of "one man stone." A quarry crushing plant is being

1 Nephelite is the mineral name more commonly used in the United States and Nepheline in Canada. Nepheline syenite and nephelite syenite are synonymous terms.

2 Donald E. Sharp, "Feldspar as a Constituent of Glass," Nat. Feld. Assn., 1937, p. 21.

installed to crush the rock to about four-inch size and eliminate hand sledging. The broken rock is loaded into motor trucks and hauled to the pilot mill.

The problem of milling is to reduce the size to 20 mesh, and finer, and to reduce the iron content from the 1 per cent in the original rock to a maximum of 0.6 per cent $Fe_2O_3$ in the finished product. Fortunately, the iron occurs in the form of magnetite (magnetic oxide of iron) in small individual crystals. Crushing and grinding to minus 22 mesh is adequate to liberate most of the magnetite. The rock is crushed in jaw crushers and rolls and screened to 22 mesh, then passed over a magnetic drum which removes the bulk of the magnetite, thence to a three roll, high intensity magnetic separator, where the more feebly magnetic particles are removed as tailings. The magnetic separator also removes most of the muscovite mica. The finished product is a pure white granular material, consisting of the mixture of nepheline and feldspar with a very small amount of muscovite mica, and containing 0.05-0.06 per cent $Fe_2O_3$.

Fig. 2 is a simplified and idealized flow sheet showing the milling process at the Lakefield, Ontario, mill. The new mill at Rochester, N. Y., will follow the same basic principles but several new ideas will be used to give greater milling efficiency and further insure a a low iron content.

In the new mill a dryer will be used to insure dry rock at all times. The fine dust will be removed from the finished product by air separation. A fine grinding unit will be installed to make 100, 140 and 200 mesh products.

While there is no problem of sorting, blending, or chemical control, due to the natural uniformity and purity of the rock, a chemical laboratory is maintained and constant analyses are made of the mill products and of all shipments. These analyses are for the adjustment and control of the magnetic separators to take care of fluctuations in temperature, humidity and feed rate. Analysis records covering the period of over a year of operation of the mill show remarkably uniform contents of alumina, iron and the fluxing oxides.

Nepheline syenite is primarily a self-fluxing source of alumina in glassmaking; that is, it contains enough soda and potash to be readily fusible without the addition of other ingredients. It is unlike aluminum oxide, aluminum hydroxide, and simple aluminum silicates, such as kyanite, pyrophyllite, clay, etc., which contain no fluxing oxides and thus fuse with difficulty unless mixed with other fluxes. Nepheline syenite contains about 10 per cent $Na_2O$ and 5 per cent $K_2O$ or a total of 15 per cent fluxing oxides. The soda potash ratio averages 2:1. While the fluxing oxides do not exist in nepheline syenite in the approximate feldspar eutectic ratio of 8:5, there is some rough agreement, and the oxide in excess is the more easily fusible $Na_2O$. This may account, in part at least, for its easy melting characteristics.

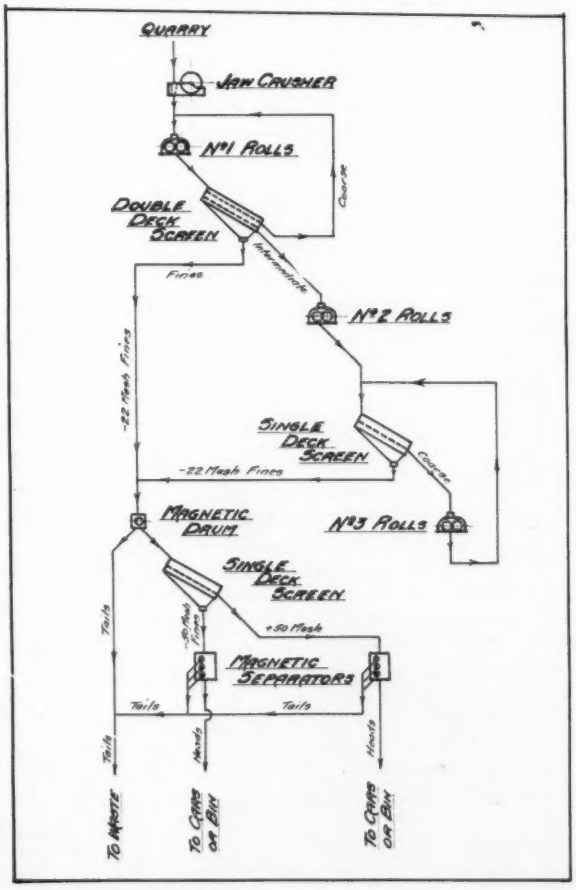
Since soda, which has a lower melting point, predominates in nepheline syenite, and since the total fluxing oxides are high, it would be expected that less soda ash would be needed when nepheline syenite is substituted, as a source of alumina, in a glass batch. This has been found to be the case in actual practice.

We have shown that the alumina content of nepheline syenite averages around 24 per cent. Sharp[2] uses an average or typical figure of 17.5 per cent $Al_2O_3$ in feldspar, but we will assume 18 per cent. This fact is significant in itself, but it is still more important when we consider the ratios between alumina and fluxes, alumina and silica, alumina and iron, fluxes and silica, etc. Nepheline syenite contains around 59 per cent silica to 69 per cent for feldspar, and both contain about .06 per cent iron expressed as $Fe_2O_3$.

TABLE 2—COMPARISON OF NEPHELINE SYENITE AND FELDSPAR

| | *Nepheline Syenite* | *Feldspar* |
|---|---|---|
| $Al_2O_3$—Per Cent | 24 | 18 |
| Relative Difference | 33 per cent more | |
| $Fe_2O_3$—Per Cent | 0.06 | 0.06 |
| $Al_2O_3$: $Fe_2O_3$ Ratio | 400:1 | 300:1 |
| Per Cent Equalized on $Al_2O_3$ Basis | 0.045 | 0.06 |
| Alkalies—Per Cent | 15 | 13 |
| Silica—Per Cent | 59 | 69 |
| Alkali-Silica Ratio | 1:4 | 1:5.3 |

Nepheline syenite has been used commercially for well over a year by several companies. Large scale plant tests and small scale laboratory tests have been made by many more companies and research work has been done by several glass technologists. However, the field is so wide that definite claims are not, and will not, be made until much more substantiating data is available. But those who have worked with the material have reported a number of interesting things and it may be worth while to




• *Idealized flow sheet for Lakefield plant.*

record them here, not as definite claims, but as points for future investigation to prove or disprove.

For example, it has been reported that when nepheline syenite is used as the source of alumina in glass batches, the melting temperature may be lowered with increased fluidity of the melt. The reason for this may not be apparent from the composition, although several theories have been advanced. Further work is necessary to establish this point, to measure the effects quantitatively and to find the reason. Likewise to be investigated is the report that the finished glass in which nepheline syenite has been used, is clearer and more brilliant.

Of course the well-known effects, characteristic of alumina in glass, such as greater strength, increased resistance to weathering, etc., are obtained with nepheline syenite as the source of alumina. Sharp[2] has covered this subject in detail and need not be discussed further here.

Several observers have reported beneficial effects, not predictable from the analysis, and in order to obtain accurate qualitative and quantitative data a program of research has been started by the producers of nepheline syenite.

## G. C. A. ACTIVITIES

(*Continued from page* 203)

Last fall the Association retained Bert W. Hendrickson as legal counsel for broken bottle cases. Mr. Hendrickson has had an active winter advising on numerous cases, and actually participating in several that have come to trial. We believe that this service has developed a method of defense that should go a long way toward taking the racket out of this type of case. Probably the greatest benefit has been that this subject has come definitely before the membership, and that they are now securing evidence and facts as soon as they are advised of a broken bottle accident.

As a further defense against broken bottle cases the Board of Directors authorized a research project to develop a standard method for testing bottles. This project is under the direction of Dr. Frank W. Preston, who has employed Dr. L. G. Ghering to do this work.

It was determined that testing procedures are neither uniform nor extensive. Therefore, scientifically strained standards for polariscope work have been developed. In addition, standard practices are being developed for ring section examination under the microscope, pressure tests and thermal shock tests. These practices should materially aid the defense of broken bottle cases and also be of help in plant operation.

Chief among the problems dealt with by the traffic department of the Association since the September, 1936, meeting was the petition of the railroads before the Interstate Commerce Commission (Ex Parte 115) to increase railroad freight rates. The reason is that the railroads claim that they need more revenue. Involved are commodities in which the glass container industry is directly interested.

There is a run of separate propositions involving changes in rates, classification, rules and regulations, most of which are in some manner tied in with the movement represented by the Increase Rate Case. A revision of the rates in, to and from the Southwest has been completed. A revision of rates in Southern territory and between that territory and Official territory is about to begin and it will bear on our traffic.

Truck rates are not stabilized and are constantly being readjusted. In addition to many cases before the Interstate Commerce Commission it is reported that about 2,600 bills regulating motor carriers have been introduced in State Legislatures.

Standardization of finishes and sizes has been an important problem during the last year. The Committee realizes that authorization of new standards entails extra expense in both the cap and glass manufacturing fields; however, it realizes also that improvement in manufacturing technique at times makes changes necessary. From the many submitted 15 new finishes were issued, with revisions to 20 of those existant. In progress of authorization are five additional, the most important of these being the series of thin blown tumblers, in which the American Glassware Association is cooperating.

### Statistical Report

The statistical report covered two phases. In the past three months the Association has made a complete survey of both labor and capacity, by personal visit, of 39 companies operating 61 plants east of the Rockies.

Gathered and presented in a much more complete form than the previous payroll analysis, the labor survey enables each company to make a ready comparison of labor conditions with those prevalent in that area and with the industry as a whole. The survey presented complete data on employment, hours, and pay rates for the past period and for the first part of 1936. The industry is given in a composite form in four subdivisions by areas, and in separate composite for milk bottle manufacturers.

The production statistics show the number of tanks in active operating schedules, total volume of production based on present capacity and a breakdown of the year's figures. In the last complete survey (1933) ratings were figured at nine square feet per packed ton. Today the rating is nearer six, or a yearly capacity of 64,400,000 gross of bottles. The actual production for the month of April was 4,500,000 gross, or an estimated 54,000,000 gross per year. The projected ratio of actual to capacity is therefore around 73 per cent.

The general advance in production is reflected in all lines of containers except the "general," which have remained practically as indicated on the chart. Unusual buying in anticipation of a rise in price resulted in an abnormal rise. This is influenced to a great extent by the lack of accurate pre-planned expectancy by the beverage and brewing industries.

The Association reelected all of its officers and directors, making the official family consist of: W. H. McClure, Hazel-Atlas Glass Co., president; H. C. Mandeville, Thatcher Manufacturing Co., first vice president; George S. Bacon, Whitall Tatum Co., second vice president, and V. L. Hall, Glass Container Association, secretary-treasurer. Directors: F. J. Petty, Ball Brothers Co.; F. L. Lloyd, Crown Cork & Seal Co.; H. L. Lonsdale, Phoenix Metal Cap Co.; H. C. Mandeville, Thatcher Manufacturing Co.; J. H. Rau, Jr., Fairmount Glass Works; P. I. Heuisler, Maryland Glass Corp.; C. D. King, General Glass Corp.; I. R. McDonald, Dominion Glass Co.; G. F. Lang, Carr-Lowrey Glass Co.; R. M. Barnard, Owens-Illinois Glass Co.; A. F. Reed, F. E. Reed Glass Co.; I. R. Stewart, Anchor Cap & Closure Corp.; R. R. Underwood, Knox Glass Associates. Officers of the Association are also directors.

# EQUIPMENT AND SUPPLIES

## PERMOCHARTS

Manufacturers who use recording meter charts whose life is limited to a single days use, will be interested in the "Permochart", recently introduced by the Permochart Company, Pittsburgh. The "Permochart" may be wiped clean by a damp cloth, the old record destroyed, and the chart made available for reuse. It has a smooth, hard finish, and is wrinkle proof, waterproof, and non-inflammable. It is made to fit all types of recording instruments for flow, temperature, pressure and vacuum, humidity, electricity, motion, speed, etc. No change of meter is required. A circular describes this product in detail.

## CELECTRAY POTENTIOMETER

The C. J. Tagliabue Mfg. Co. has just announced a new recorder called the *Celectray*. A sensitive mirror galvanometer is the primary controlling element in which an inert beam of light takes the place of the customary metal pointer. The beam of light from the galvanometer in moving on and off a phototube passes the "controlling edge" of a screen, thus operating relays which control a reversing motor driving the moving contact. The new instrument, therefore, is not a "photoelectric potentiometer" in the sense that a balance of photoelectric current is implied.

The galvanometer is free at all times from mechanical engagement, and this, combined with its low moment of inertia, permits rapid balancing and control actions. Furthermore, a high current sensitivity is available, permitting the use of high resistance, or of very long, thermocouple leads without material loss of accuracy in the balancing.

## CATALOGS RECEIVED

*Dust Collectors.* Catalog No. 79. The C. O. Bartlett and Snow Co., Cleveland. This 36 page catalog gives a complete description of the design and operation of the dust collecting unit, together with two sample installations showing its application and use. In addition the booklet contains eight pages of handy technical data relating to airflow through pipes and kindred subjects.

*Electric $CO_2$ Meters.* Brown Instrument Company, Philadelpia. Catalog 3005. The Brown System of combustion control is presented in both single and multiple units. Illustrations and descriptions of the various meters and control devices are given together with schematic diagrams.

*Watthour Meters.* Catalog GEA-2404A. General Electric Co., Schenectady, N. Y. A colorful catalog presenting the new two element single-disk meter for single and polyphase current. Fully illustrated, including wiring diagrams.

*Spectrometric Equipment.* Catalog D221. The Bausch & Lomb Optical Company, Rochester, N. Y. A catalog giving the basic theory and design of spectrometric equipment and the various units available, from the small spectrometer to the universal spectrophotometer. Diagrammatic and pictorial illustrations.

*Quarter Turn Valves.* Homestead Valve Manufacturing Company, Coraopolis, Pa. A pocket size catalog giving specifications, sizes and prices for a complete line of valves, for control of both water and air. Each type is shown in a cutaway illustration.

*Universal Camera Microscope.* Pfaltz and Bauer, New York. A catalog describing the Reichart instrument which for the first time combines petrographic microscope, light source and focuser, refractometer and camera. The operation and usage is explained and illustrated in both cut-away diagrams and pictures.

*Centrifugal Pumps.* Bulletin No. 5814F. Fairbanks, Morse & Co., Chicago. Specifications and details of ball bearing centrifugal pumps, which are offered in a number of sizes, in electric motor, engine, turbine and combination models. Illustrated.

*Polarizing Microscopes and Accessories.* Catalog D-130. Bausch and Lomb Optical Company, Rochester, N. Y. Polarizing microscopes, including petrographics, with various accessories such as lamps, analyzers and photomicrographic equipment, are described in this catalog. Prices and specifications are given in chart form. Fully illustrated.

*Motorpumps.* Ingersoll-Rand Company, New York. A new catalog describing the Cameron Motorpumps. These are compact machines, combining electric motor and centrifugal pump in a single unit. The range in capacity is up to 1000 gallons per minute, for heads to 500 feet, with motors up to 40 HP.

*Millivoltmeter Pyrometers.* Catalog No. 15-C. The Brown Instrument Company, Philadelphia. This new catalog describes the complete line of Brown Millivoltmeter Type Pyrometers, including Recording, Indicating, and Controlling instruments, and auxiliary equipment, such as switches, relays, valve mechanisms, and thermocouples. It also includes information on optical pyrometers, and instruments for indicating furnace atmospheres, and automatically controlling combustion.

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## PHOTOELECTRIC GLOSS METER

A photoelectric meter for the comparative measurement of the gloss and degree of smoothness of a surface finish has been introduced by Pfaltz and Bauer, Empire State Building, New York, importers and distributors of the photoelectric equipment manufactured by Dr. Bruno Lange. In addition to the measurement of direct reflection this instrument may be used for diffused reflection and translucency. thus lending itself to laboratory use for control purposes, particularly in the flat, plate, ground and mirror glass fields.

A diagrammatic assembly, and the path of the rays is given in Fig. 2. (1) is the light source, a six volt, concentrated filament bulb; (2) and (3) are the condensers, through which the radiation to be measured is reproduced on the diaphragm (5); (6) is the photoelectric cell and (7), one of the three centering screws of the lamp. The light passes from the source, through the condenser, and is centered on the object to be measured. At this point it is reflected from the object through the second condenser onto the photocell.

The light upon striking the photocell activates it, causing current to pass through the circuit and deflecting the indicator needle. The indicator scale is graduated from one to one hundred, making any reading a percentage.

In the measurement of diffused reflection the cell (6) is placed in position (8). Light permeability may be determined by contrasting the diffusion of the object on black and white plates, and interpolating the results in a simple formula.

The distributors claim that the instrument will give accurate, reproducible control results. Further, it is said that in use with transparent glass there is no difficulty encountered through reflection from both surfaces of the object.

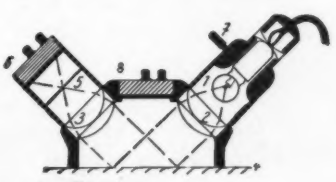


*Fig.* 1

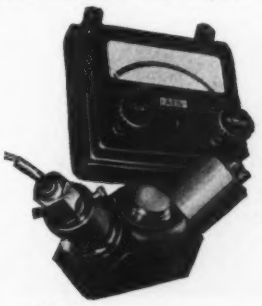
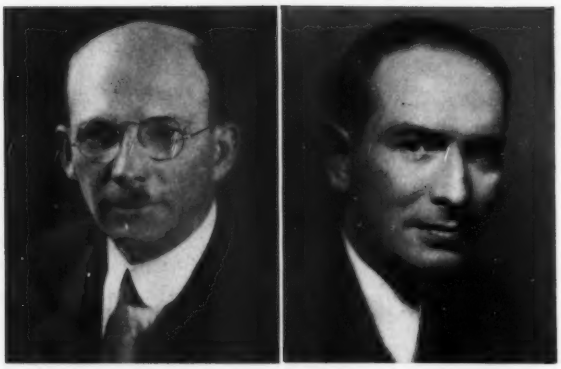


*Fig.* 2



*James Bailey* *A. K. Lyle*

### HARTFORD-EMPIRE ACQUIRES BAILEY & SHARP

The Hartford-Empire Company has announced that Messrs. James Bailey and Donald E. Sharp of the Bailey and Sharp Company, Hamburg, New York, together with two assistants, will soon join Hartford.

In 1929 the Bailey & Sharp Company took over the business commenced in 1925 by Donald E. Sharp, and since that time the company has been known as one of the foremost firms of consulting engineers and glass technologists. For several years past they have been associated with the Hartford-Empire Company as consultants, but Hartford now considers it desirable to give its licensees the benefit of the exclusive services of these two men and also of two of their assistants—Aaron K. Lyle, chief chemist, and William Horak, who has been in charge of ceramic and petrographic work.

Mr. Sharp was born in Corning, New York, and attended the University of Wisconsin and Carnegie Institute of Technology. His earlier practical experience included work at the Corning Glass Works, in the Physics Department of the University of Wisconsin, and in the United States Bureau of Standards. During the war and until 1921, he was assistant to Dr. George W. Morey of the Geophysical Laboratory staff. At that time Dr. Morey, on temporary leave of absence, was acting as manager of the Spencer Lens Company Optical Glass Plant. Later Mr. Sharp succeeded Dr. Morey as technical director and manager of this plant.

*William Horak* *Donald E. Sharp*

Mr. Bailey was born in Gowanda, N. Y., and graduated from Lehigh University in mechanical engineering. He was formerly employed by the Corning Glass Works as an engineer in the Mechanical Development Department, later leaving to become Vice-President of the Bailey & Sharp Company.

It is believed that this addition to the organization of the Hartford-Empire Company will greatly increase the scope of the services which the company has furnished to its licensees for many years. The Bailey & Sharp Company will continue its business in Hamburg until such time as the work now under way has been completed and its existing commitments fulfilled. In the early summer Messrs. Bailey and Sharp and their two associates will take up their residence in Hartford.

### CERAMICS AT TORONTO

The University of Toronto announces that it will expand its instruction in ceramics beginning with the new semester. A four year course dealing with 'Ceramics and Non-Metallic Industrial Minerals" will be offered under the leadership of Robert J. Montgomery of the Faculty of Applied Science and Engineering, replacing the former optional advanced study.

The curriculum is designed to take care of the increased importance of the non-metallic industrial minerals and will emphasize chemistry and physical chemistry. In addition to the usual ceramic courses and the necessary general engineering subjects, instruction in Economic Geology, Petrography and Mineralogy will be included.

### PITTSBURGH-CORNING BUILDS

Ground has been broken at Port Alleghany, Pa., for the erection of the first manufacturing unit of the newly formed Pittsburgh-Corning Corporation. The factory will be ready for production in November. According to President H. S. Wherrett, the new plant will be more completely automatic than any yet constructed in its field; novel, specialized machinery having been developed for the purpose. The building itself will be constructed of the same glass block to which its manufacturing facilities will be dedicated, wide panels of glass being supported on a framework of brick and structural steel.

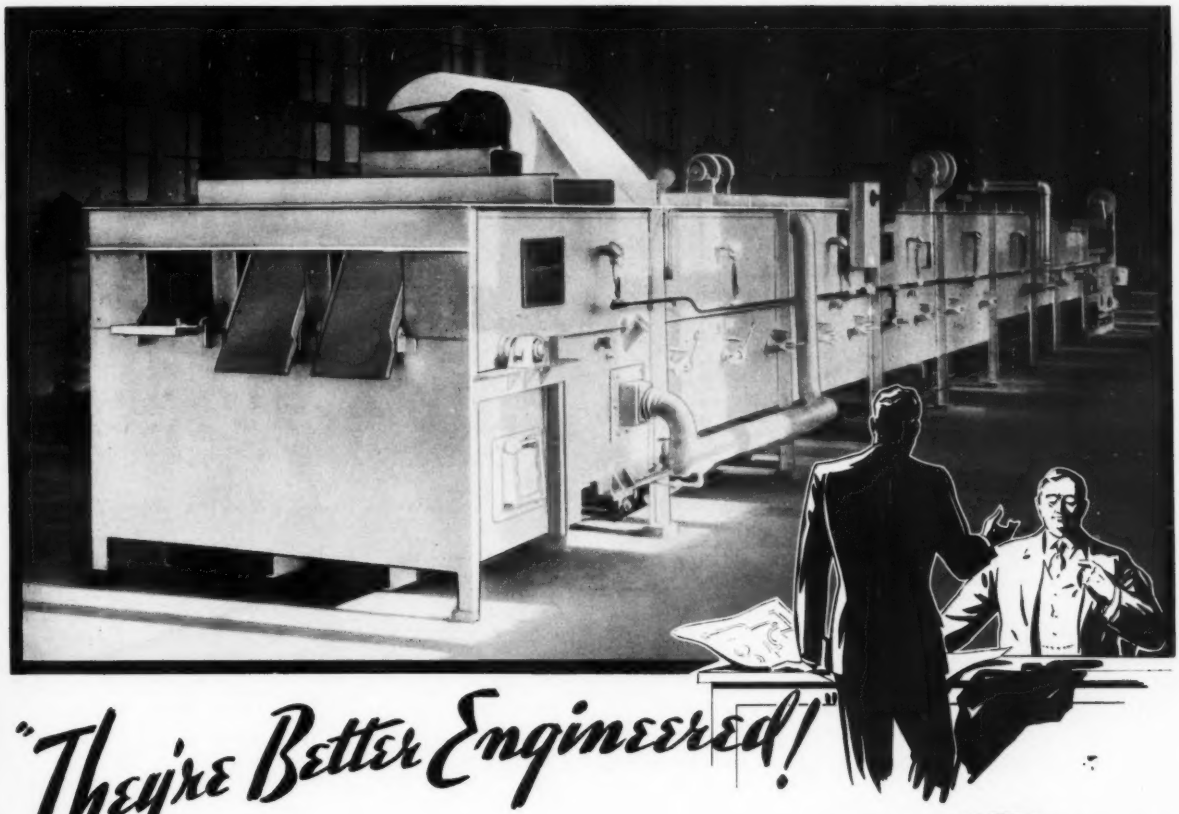
Sales offices will be established in several of the larger cities, and distribution effected through the 74 warehouses of the Pittsburgh Plate Glass Company. J. P. Staples, for 15 years in charge of industrial sales for the Macbeth-Evans Glass Company, will be general manager.

### OPTICAL LENSES FROM PLASTICS

Optical lenses moulded from synthetic resins were displayed by the co-inventor, Mr. Koch de Gooreynd, at the British Empire Building, Rockefeller Center, on April 30. These lenses are claimed to have optical properties equal to those made of glass and have the added advantages of being unbreakable and inexpensive.

They are produced, in mass, by a specially designed moulding machine. The die for any desired lense, once ground, will mould about 500,000 lenses.

An American company is being formed to manufacture lenses under a licensing agrement from synthetic resins to be supplied by the DuPont Company.



# "They're Better Engineered!"

● Why do glass plant operating executives buy SC Controlled Recirculation Lehrs? One told us tersely it is because "They're better engineered."

Probably that is why a score of others have made the initial installation of these lehrs, and then have ordered additional SC equipment as the need arose.

SC Engineers have put into SC equipment for the glass industry all the benefits gained from extensive and varied experience gained from the development and building of heat treating and melting equipment for many industries, as well as from broad yet specialized technical knowledge. Laboratory and shop facilities also play their part in building equipment of which it can be justly said: "It's better engineered."

Better engineering starts with a better principle of operation; it includes sound, durable construction from materials properly selected to withstand increasingly higher temperatures. It provides increased flexibility in heat distribution and improved temperature and atmosphere control. It assures more dependable and economical operation, improved quality and greater uniformity in the ware being produced.

Regardless of height, width, length, temperature of speed of conveyor, SC Controlled Recirculation Lehrs are "better engineered." If you want to know the facts from actual operation, let us tell you how to get them, without obligation.

## WHAT IS *Your* PROBLEM?

Do you need equipment to:

- Anneal at higher temperatures
- Melt Special Glasses at higher temperatures
- Accomplish unusual results in finished product
- Anneal ware traveling at different speeds in same lehr
- Heat glass from cold for hardening
- Heat glass for molding
- Anneal glass requiring different temperatures in same lehr at same time
- Anneal special ware on high speed conveyors
- Anneal optical glass
- Increase annealing capacity with limited space for lehr

Whatever the job to be done—whether it ever has been done before or not—if it has to do with heat treating, submit it to SC Engineers.

SC LEHR
THE ONLY LEHR WITH
*Controlled Recirculation*

**Surface Combustion Corporation**

**TOLEDO, OHIO** (SC) ***Sales and Engineering Service in Principal Cities***

# CURRENT PRICES OF GLASS-MAKING MATERIALS

**FURNISHED BY PRODUCERS, MANUFACTURERS AND DEALERS**

## Base Materials

| | | Carlots | Less Carlots |
|---|---|---|---|
| Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh | ton | 42.00 | 45.00 |
| Barium sulphate, in bags | ton | 19.00 | 24.00 |
| Barium sulphate, glassmaker's, carlots, bulk f. o. b. shipping point | ton | 15.00-16.00 | 18.00 |
| Borax ($Na_2B_4O_7 10H_2O$) | lb. | .... | .... |
| Granulated | In bags, lb. | .020 | .0245-.027 |
| Powdered | In bags, lb. | .0225 | .027-.0295 |
| Boric acid ($H_3BO_3$) granulated | In bags, lb. | .0475 | .0525-.055 |
| Calcium phosphate ($Ca_3(PO_4)_2$) | lb. | .07 | .07⅛ |
| Cryolite ($Na_3Al\ F_6$) Natural Greenland (Kryolith) | lb. | .08½ | .09 |
| Synthetic (Artificial) | lb. | .08½ | .09 |
| Feldspar— | | | |
| 20 mesh | ton | 11.00-13.25 | |
| 40 mesh | ton | 11.50-13.75 | |
| Granular | ton | 11.75-14.00 | |
| Semi-granular | ton | 11.00-13.25 | |
| L. C. L., (Min. 2 tons) $3.00 per ton additional plus charge for bags | | | |
| Fluorspar ($CaF_2$) domestic, ground, 96-98% (max $SiO_2$, 2½%) | | | |
| Bulk, carloads, f. o. b. mines | ton | 31.50 | .... |
| In bags | ton | 33.10 | 38.00-40.60 |
| Kryolith (see Cryolite) | | | |
| Lead Oxide ($Pb_3O_4$) (red lead) (N. Y.) | lb. | .085 | 10¼ |
| In 5 Ton lots | lb. | .... | .09 |
| Less than 5 Tons | lb. | .... | .0 95 |
| Lime— | | | |
| Hydrated ($Ca(OH)_2$) (in paper sacks) | ton | 10.50 | .... |
| Burnt (CaO) ground, in bulk | ton | 7.00 | .... |
| Burnt, ground, in paper sacks | ton | 9.00 | .... |
| Burnt, ground, in 280 lb. bbls. | Per bbl. | 2.25 | 2.25 |
| Potassium carbonate— | | | |
| Calcined ($K_2CO_3$) 96-98% | lb. | .065-.0675 | .07⅜ |
| Hydrated 80-85% | lb. | .055 | .0575 |
| Salt cake, glassmakers ($Na_2SO_4$) | ton | 18.00 | 27.00 |
| Soda ash ($Na_2CO_3$) dense, 58%— | | | |
| Bulk | Flat Per 100 lb | 95 | .... |
| In barrels | Per 100 lb. | 1.35 | .... |
| In bags | Per 100 lb. | 1.10 | .... |
| Sodium nitrate ($NaNO_3$)— | | | |
| Refined (gran.) in bbls. | Per 100 lb. | .... | 2.25-2.65 |
| 95% and 97% | | | |
| Bulk | Per 100 lb. | 1.275 | .... |
| 200 lb. bags | | 1.34 | 1.39 |
| 100 lb. bags | | 1.375 | 1.425 |

## Special Materials

| | | Carlots | Less Carlots |
|---|---|---|---|
| Aluminum hydrate ($Al(OH)_3$) | lb. | .... | .03½ |
| Aluminum oxide ($Al_2O_3$) | lb. | .04 | .05 |
| Antimony oxide ($Sb_2O_3$) | lb. | .... | .16¾ |
| Arsenic trioxide ($As_2O_3$) (dense white) 99% | lb. | .03 | .03¼ |
| Barium nitrate ($Ba(NO_3)_2$) | lb. | .... | .07¾ |
| Rutile ($TiO_2$) powdered, 95% | lb. | .10-.12 | .13-.15 |
| Sodium fluosilicate ($Na_2SiF_6$) | lb. | .06¼ | .06¾ |
| Tin Oxide ($SnO_2$) in bbls. | lb. | .... | .60 |
| Zinc Oxide (ZnO) | | | |
| American process, Bags | lb. | .06 | .06¼ |
| White Seal, 150 lb. bbls. | lb. | .08¼ | .08½ |
| Green Seal bags | lb. | .07½ | .07¾ |
| Domestic White Seal bags | lb. | .08 | .08¼ |
| Red Seal, bags | lb. | .07 | .07¼ |
| Zircon | | | |
| Granular (Milled .005-.02c higher) | | .07 | .07½-.08 |
| Crude, Gran. (Milled .005-.02c higher) | | .03½ | .04-.05 |

## Coloring Materials

| | | Carlots | Less Carlots |
|---|---|---|---|
| Barium selenite ($BaSeO_3$) | lb. | .... | 1.50-1.75 |
| (Commercial, 25% Selenium) | lb. | .... | .90 |
| Cadmium sulphide (CdS) | lb. | .... | .90-1.05-1.10 |
| Chromite | lb. | .... | .0215 |
| Cerium hydrate | | | |
| 100 lb. drums and 600 lb. barrels | lb. | .... | .60 |
| Chrome Oxide Green, 400 lb. bbls. | lb. | .... | .22-.26 |
| Cobalt oxide ($Co_2O_3$) | | | |
| In bbls | lb. | .... | 1.41 |
| In 10 lb. tins | lb. | .... | 1.51 |
| Copper oxide | | | |
| Red ($Cu_2O$) | lb. | .... | .20¼ |
| Black (CuO) | lb. | .... | .18½-20¼ |
| Black prepared | lb. | .... | .22 |
| Iron Oxide— | | | |
| Red ($Fe_2O_3$) | lb. | .... | .0425 |
| Black ($Fe_3O_4$) | lb. | .04½ | .... |
| Iron Chromate | lb. | .... | .035-.05 |
| Lead Chromate ($PbCrO_4$) | lb. | .... | .16 |
| Manganese, Black Oxide | | | |
| In Paper bags | ton | 55.00 | 58.00-63.00 |
| In Burlap bags | ton | 57.00 | 60.00-65.00 |
| In Casks | ton | 59.00 | 63.00-67.00 |
| Neodymium oxalate, 50 lb. drums | lb. | .... | 3.00 |
| Nickel oxide ($Ni_2O_3$), black | lb. | .... | .35-.40 |
| Nickel monoxide (NiO), green | lb. | .... | .35-.40 |
| Potassium bichromate ($K_2Cr_2O_7$)— | | | |
| Crystals | lb. | .... | .09 |
| Powdered | lb. | .... | .91⅛-.09½ |
| Potassium Chromate ($K_2CrO_4$) 100 lb. kegs | lb. | .... | .27 |
| Powder blue | lb. | .... | .18¾-.19¼ |
| Rare earth hydrate | | | |
| 100 lb. drums | lb. | .... | .35 |
| 325 lb. barrels | lb. | .... | .30 |
| Selenium (Se) In 100 lb. lots | lb. | .... | 2.00 |
| In lesser quantities | lb. | .... | 2.10 |
| Sodium bichromate ($Na_2Cr_2O_7$) | lb. | .06⅝ | .07 |
| Sodium chromate ($Na_2CrO_4$) Anhydrous | lb. | .... | .08⅜ |
| Sodium selenite ($Na_2SeO_3$) | lb. | .... | 1.80-2.00 |
| Sodium uranate ($Na_2UO_4$) Orange | lb. | .... | 1.50-1.55 |
| Yellow | lb. | .... | 1.50-1.55 |
| Sodium uranyl carbonate | lb. | .... | .80-.90 |
| Sulphur (S)— | | | |
| Flowers, in bbls. | Per 100 lb. | 3.35 | 3.70-4.10 |
| Flowers, in bags | Per 100 lb. | 3.00 | 3.35-3.75 |
| Flour, heavy, in 250 lb. bbls. | Per 100 lb. | 2.90 | 3.25-3.65 |
| Uranium oxide ($UO_2$) (black, 96% $U_3O_8$) 100 lb. lots. Black | lb. | .... | 2.25 |
| Yellow orange | lb. | .... | 1.50 |

## Polishing Materials

| | | Carlots | Less Carlots |
|---|---|---|---|
| Emery, Turkish | lb. | .... | .07 |
| Pumice Stone, | | | |
| American Ground Italian FFF, FF, F | lb. | .... | .03 |
| 0, 0½, ½, 1. | lb. | .... | .03¾ |
| Putty Powder | lb. | .... | .38-.42 |
| Rotten Stone | lb. | .... | .03 |
| Rouge, Red | lb. | .... | .14 |
| Black | lb. | .... | .16 |

## GLASS FIBRES

(*Continued from page* 201)

followed for any other textile material, and it is handled with present standard equipment. The limit of temperature at which a glass-wound unit can be operated is determined only by the impregnation used on the unit. In addition, there is no iron present as an impurity, and no combustible material which can be injured by arcing in event of a break in the line.

The dielectric strength of glass tapes is very high, comparing favorably with varnished cambric. With the proper impregnation, the dielectric strength is approximately 1,200 volts per mil. In addition, the insulation resistance of glass tapes, or glass yarns, is extremely high, comparing favorably with rubber and varnished cambric.

During the initial stages of the textile development, glass textiles were somewhat inclined to irritate delicate skins. This irritation was caused by "tramp" coarse fibers, that is, fibers with a diameter of 0.00035 to 0.0005 inch. With increased control on the operation these tramp fibers have been reduced in number to an almost negligible quantity, and as a result, glass textiles are soft, pliable, and readily handled at the present time.

An interesting fact has been found in that glass yarns have at least as high knot strength as other yarns, when properly constructed. For instance, a cotton yarn will lose about 25 per cent of its strength (in tension) when knotted. A properly constructed glass yarn of approximately the same weight per yard initially had a tensile strength of 22 pounds, and after knotting, this was reduced to 18 pounds, a loss of 8 per cent of its initial strength.

At the present time, it is felt that the textile development has gone only far enough to justify application in the two fields specifically mentioned. However, it is anticipated that in the near future, a number of other fields will be opened up to Fiberglas textiles. If it is necessary for the materials to be colored, beautiful tints can be obtained throughout the entire range of the spectrum. It is not beyond the range of imagination to expect glass textiles to take their place in hotel tapestries, theatre curtains, and other applications where fire resistance, chemical stability, and long life are important.

## DR. WEYL LECTURES AT URBANA

Dr. Ing. Woldemar Weyl, head of the department of glass research at K. W. I. fur Silikatforschung at Berlin and at present visiting professor in Ceramics at Pennsylvania State College, presented a series of four lectures on glass at the University of Illinois on May 13, 14, and 15.

In the opening lecture he discussed "The Constitution of Glass." He remarked that at present the only satisfactory definition for glass, a supercooled liquid, all solid substances that are not crystalline, is a negative one, and that less is known about the liquid state of matter than the gaseous and solid states. Four questions were presented which were covered in the course of the lecture—why does not the law of additivity apply to glasses, why are glasses stable, why do glasses having the same composition have different properties, and what effect do mineralizers have?

A continuation of the discussion was made in the second talk on "The Absorption Spectra of Solutions and Glasses; A Tool for Investigating Intermolecular Forces and Constitution Problems." Having established the fact that associations and dissociations in glasses accounted for their properties, a method was necessary to study this phenomena. The method of absorption spectra was used, after the measurement of electrical conductivity and viscosity changes had been found unsatisfactory. In this lecture he discussed the influence of the nature of the solvent on the absorption spectra of solutions citing examples in aqueous solutions, glasses, and in organic chemistry. Color oxides were used as indicators in the study of the compositions of glasses.

"Colored Glasses" was the topic of the third talk. Colloidal colors, colors due to ions, predominated in glasses. Dr. Weyl discussed the effect of temperature and the composition of the base glass in glasses containing iron, manganese, chromium, uranium, copper, cobalt, or nickel. The role of arsenic in glass was studied, both as an oxidizing agent, changing ferrous oxide to ferric, and as a reducing agent where the color of manganese is lost with additions of arsenic. He commented on the change of the glass color during annealing and the discoloration of glass under the influence of light.

In the last lecture he spoke on "The Interaction Between Gases and Molten Silicates." He stated that the equilibrium between carbonates and silicates depended on the temperature as well as time. The use of fining agents and the connection between fining and decolorizing was indicated. He further discussed the reactions between gases and glass below the softening range, and the use of gas evolution as a means of producing opacity and making "foam glasses" for heat insulation.

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